ENGINEER, ARCHITECT AND SURVEYOR.

Vol. I.—No. 9. CHICAGO DECEMBER 15. 1874. SUBSCRIPTION $2 00 PER YEAR SINGLE COPIES 20 CENTS

MANAGEMENT OF BOILERS.

EXTRACT FROM REPORT OF THE PRESIDENT OF THE HARTFORD STEAM BOILER INSURANCE CO., FOR 1873.

Cases of Deposits of sediment. There is, perhaps, no difficulty common to steam boilers that gives the owners so much trouble as the deposit of sediment, and formation of incrustation, or scale. These difficulties arise, first, from water carrying vegetable matter and dirt in suspension, and second, from solid matters held in solution, which are precipitated by high temperatures, and remain behind by evaporation. This deposition should be immediately blown out and the boiler cleaned, or it will harden and form incrustation. If the feed water of steam boilers holds lime in any of its forms, in solution, it will most surely produce scale. We find, in the various waters used in boilers, carbonate of lime, sulphate of lime, salts of iron, magnesia, alumina, silica, and more or less organic matter. * * Heating water more thoroughly expels the carbonic acid and consequently its carbonate of lime. Hence the deposition of lime in steam boilers. The carbonate of lime usually deposits as a loose fine powder, forming a white or whitish slush or sludge with the water. The carbonate of magnesia behaves in very much the same way. When the carbonate of lime is in considerable quantities, it remains soft for some time if not exposed to too high temperature. When the boilers are blown down, if they have been properly cooled off previously, the carbonate of lime will be found as a fine powder of a light color. But if the boiler has been blown out while the plates, brick-work and flues are at a high temperature, the slush or sludge becomes baked hard on to the plates, and it is from this circumstance that many boilers are badly coated with hard incrustation from both carbonate and sulphate of lime.

It has generally been supposed that a deposit in a soft state caused little or no injury to a boiler; but our experience has proved conclusively that the contrary is true. The impalpable powder found in a boiler, when empty and dry, is mainly carbonate of lime, and, on account of its lightness, it is long held in suspension. When the water from constant evaporation, and little or no blowing, becomes saturated with this material, it is rendered unfit for generating steam on account of the resistance offered to the escape of the steam bubbles and to the free convection of heat. A deposit of slush or sludge collects on the bottom, around the seams, and in fire box boilers around the furnace sheets and in the water legs. Its presence is detected by leakage at tne seams, fractures at the edge of the plates, and in the line of rivets, and by over heating, aud consequent depression of portions of the plates where it rests.

This difficulty is greatly aggravated if grease finds its way into the boilers. The grease appears to combine mechanically with the carbonate of lime, and sinks on to the plates when the boilers are at rest. It becomes a loose, spongy mass, which is not carried off by the circulation, but, by its contact with the plates, keeps the water from them and, by offering resistance to the free transmission of heat, causes overheating and burning of plates. Before we had fully investigated this subject, our opinion was, in many instances, where boilers were leaking badly and showed indications of having been burned, that it was caused by the carelessness of the engineer in starting his fires with no water in the boiler.

From what has been said it will be seen that open feed-water heaters, into which the exhaust steam from the engine is discharged, with no apparatus for extracting or separating the grease and lime from the water, are to be used with caution. Those provided with separating chambers or plates we have found to work well, particularly when the water held any considerable amount of solid substance in solution. * * The scale on boilers which we call sulphate of lime is almost invariably mixed with other ingredients, and its hardness and color depend upon this circustance. This scale is not usually deposited in uniform layers, but is of irregular formation. It is heavy and consequently no longer held in suspension, but deposits and forms one of the most troublesome scales that the steam user has to contend with.

The question will of course be asked, what is the remedy for the difficulties enumerated above? The answer to this cannot be direct and applicable to each and every case, for the water used in feeding boilers is, to a certain extent, different in each case. Hence, only general instructions can be given, and for individual cases, personal inspection and investigation must be made.

In the first place, if it is found that the water in a boiler is throwing down any considerable quantity of carbonate of lime, frequent blowing (only an inch or two at a time) will be found beneficial. If the impurity manifests itself at the gauge-cocks, and they become furred, a surface blow may be advantageously used. Never under any circumstances *blow down* a boiler when hot and under a working pressure, for under such circumstances much of the impurity held in suspension lodges on the tubes and flues, and finds its way into the water legs of locomotive boilers, and those with internal furnaces, and immediately burns on, forming a hard scale that can only be removed by hammer, pick and chisel. It is a fact that the scale in many boilers

is formed by injudicious blowing down. They should be allowed to cool, the ores should be drawn, and furnace doors opened so that the air can circulate freely underneath and through the flues and tubes, and when all is well cooled down, then open the "blow" and no injury will be done. The impurities held in suspension will be found in a soft plastic state, or in the form of slush or sludge, and should be removed and the boiler washed out with a hose. This process will require a longer time and more care and attention than to blow down under heavy pressure and immediately fill up again with cold water, a practice too common, and one ruinous to boilers, and whoever follows it will be troubled with leaks and stoppages the year round.

We have found potatoes and slippery elm advantageous in preventing scales in many cases. The starch or glutinous matter envelops the precipitated solid particles and prevents their adhering to each other, or to the plates and tubes. Sometimes hard scale is removed by potatoes and further difficulty prevented.

Catechu and other astringents have been found beneficial in certain kinds of water. These substances contain tannic acid, which decomposes the salts of lime and forms tannate of lime. Where such solvents are used there should be frequent blowing, and surface blowing will be judicious. If blowing is not attended properly, there will be a concentration of soluble constituents which will act very injuriously upon the iron.

Feed water heaters are of great service in removing sediment if they are of proper coustruction. But an open heater using exhaust steam, with no appliances for preventing grease and sediment from entering the boiler, is not to be relied upon, and, as I have already said, steam users should be careful in selecting a heater to get the best.

External corrosion is most frequently caused by exposure of the boilers to the weather. The boilers are sometimes almost wholly exposed, and their deterioration is very rapid indeed. Leakage from joints of plates and fittings, dripping from imperfectly fitted mountings, carelessness in allowing water when blowing down to run underneath the boilers, particularly if internally fired—all contribute to wear away the boiler and shorten its safe working age. We find boilers often entirely bricked in, and external corrosion is difficult to detect unless the brickwork is removed, which is a tedious and expensive job. The walls supporting the boilers and keeping them in place of course cannot be dispensed with, but the top and bottom of the boiler can be left open and convenient for inspection. The practice of putting wood ashes on the top of boilers is highly pernicious. If the fittings leak, the water drips down upon the ashes, producing an alkaline salt which is very destructive to the plates. Coal ashes is less destructive, but even the use of this is attended with danger. Sand is little better than nothing, being almost as good a conductor of heat as the iron itself. Coatings of felt are used with benefit, though in many places this has been superseded by a composition in which asbestos largely predominates. Calcined plaster is very good, and is extensively used. It should be laid on from one and a half to two inches thick.

Another cause of corrosion is the careless manner in which ashes are allowed to accumulate in the ash pit of internally fired boilers. It is frequently allowed to get wet and does great mischief to the plates against which it rests. To prevent external corrosion, see that the boilers are tight at their seams, and that man-hole plates are put on so as not to leak; that all the attachments have good tight joints, and that the steam pipes running over the boilers are free from leaks. Boiler makers are often very careless in fitting up their work; and in shipping boilers on cars, or otherwise, care should be taken not to subject them to unnecessary strains.

Internal corrosion is the wasting of plates or tubes, where corroded by the water. This is sometimes quite uniform, and again it is found in patches of considerable extent, It looks very much like ordinary rusting, and is not difficult to detect. In boilers covered more or less with scale its presence is often detected by red streaks where the scale is cracked. It attacks the edges of plates at the joints, and around the rivet heads. Sometimes it will attack two boilers working side by side. One will be corroded in the front part, and the other in the back part. Sometimes different sheets in the same boiler will be corroded, while others remain intact. Again, boilers will be found in what is known as a "*pitted*', condition. This is manifested by small spots in close contact being eaten into the sheet. It looks like a pock-marked face and is sometimes confluent; and what is strange about this is, that often certain sheets in the boiler will be attacked while others will remain clean and smooth, and the iron will bear the same brand on each plate. Much speculation has arisen as to the cause of this singular phenomenon. * * When internal corrosion is found in connection with scale, the best method of obviating it is to use a solvent that will remove the scale, and to keep the boiler clean as possible by frequent blowing down and washing out. If the corrosion or pitting is the result of acid in the water, it will be best to abandon the water and get a supply from some other source. Boilers are sometimes supplied from streams running out of iron bogs, and the waters of springs and wells, are often found to contain more or less acid.

Water Gauges.—When a boiler is fed by an open heater, with no effective apparatus for preventing the grease from going into the boiler, if the water contains carbonate of lime or other impurities held in suspension, they combine with the grease and oil, forming a spongy sort of scum, which floats upon the surface of the water. This is very liable to stop up the water passage to the glass water gauge, and we have found instances where the gauge indicated an abundance of water when, in fact, the boiler was nearly empty. While the water gauge may be a good auxiliary, it is never safe to depend upon it to the exclusion of the gauge cocks. Impure and muddy water will often seriously interfere with the correct working of water gauges.

Safety Valves.—It is not my purpose to discuss the merits of any particular valve, but give the results of our examinations, and what defects safety valves are liable to. The lever valve is the one most commonly used, and under the care of a competent and reliable man, is all that is needed; but in the hands of reckless parties it is liable to move the weight nearer or quite to the end if the pressure increases and the valve raises and "blows." The lever should be cut off at the point of maximum pressure required, and then an increase of load can only be effected by hanging on additional weights, which would be sooner discovered than if the weight were simply moved a few inches. We often find bricks, old iron and stones fastened on to the safety valve lever, weighting the valve so heavily that the pressure increased 100 per cent. would not lift it.

Again, safety valves are very much neglected. They should be raised every day to see that they are in working order. They are liable to become corroded to the valve seats if they are not occasionally lifted, and sometimes they are so fast as to be entirely inoperative, and consequently, "dangerous valves" instead of safety valves. The patent lock-up valves are liable to the same difficulty. If they are not raised frequently they are very liable to become corroded and useless. Every safety valve should be provided with some means for lifting it, and the best way is to have a cord adjusted with pulleys, so that it can be reached and manipulated from the front of the boilers.

Engineers are apt to neglect the safety valve, but if an appliance for lifting it is constantly before them, they will usually attend to it.

Pressure Guages.—These were almost entirely dial or spring gauges, and their variations from a standard gauge were, in many instances, very great, the extreme being from —56 to +50. The danger of running a boiler with an incorrect gauge will be understood when we take into consideration that—20 means 20 lbs. more than the indicated pressure. To illustrate: suppose a boiler is being run at an indicated pressure of 80 lbs. the guage is examined and tested and found to be—20 lbs., that is, it indicates 20 lbs. less than the actual pressure, it is plain to see that instead of 80 lbs. pressure on the boiler, there is actually 100 lbs.; and if the gauge was—50 lbs., there would be an actual pressure of 130 lbs. These extreme pressure are the exceptions, but variations of 5, 10 and 15 lbs. are very commmon. But it will be seen that, with an incorrect gauge, a steam user is entirely ignorant of the actual pressure under which his boiler is used. We have examined during the past year thousands of guages, and some interesting and curious facts have been obtained. A gauge that stands a very satisfactory test when new, may prove to be one of no reliabity whatever after a few months of actual use. Hence, the mere testing of gauges and pronouncing upon their comparative merits without putting them to actual use under the conditions in which they are to act as indicators of safety, is a mere farce, and worthy of no confidence whatever.

When we read accounts of terrific boiler explosions, and find the engineer or some other employee testifying that only a moment previous the gauge indicateded 60 lbs., or a safe working pressure, we conclude that the testimony was unreliable, or that the gauge was badly out of order; and from our experience we believe the latter is not unfrequently the case.

Cases of Deficiency of Water.—This defect arises from carelessness of the engineer generally, or of some attendant in whose care the boilers have been placed. Fires are often lighted or replenished without sufficient water in the boilers. Neglect to close blow-off cocks is another cause, as well as defective feed apparatus. Sometimes a pump will get out of order. When the pump is attached to the engine, if the latter breaks down, serious difficulty may arise, and if repairs cannot be quickly made, the fires should be drawn. A very serious explosion has occurred recently from this latter cause. A rule which should never be disregarded by an engineer or boiler attendant is —always try the gauge cocks of the boilers the first thing on entering the boiler room in the morning, then if the water has leaked out during the night it will be detected before injury is done. The usual way is, to rake up the fires and get them well agoing, and then look after the water; and many boilers have thus been nearly ruined, the *deficiency of water being discovered too late.*

USE OF SOME KINDS OF TIMBER.

At a recent meeting of the Scientific and Mechanical Society of Manchester, Eng., Mr. J. G. Lynde, C. E., City Surveyor, made the following interesting remarks in the course of his Presidential address:

The proper selection and use of timber, he said, was a matter in which they were all more or less interested, and he would offer a few observations on the subject, based on his own experience. For all ordinary purposes the kind of timber most used for pattern-making, and in temporary structures, such as traveling cranes, staging framework, and platforms for the erection of bridges and similar work, was fir, either American or Baltic, the nature and properties of the different descriptions of which, as usually met with in our market he proposes shortly to describe; but before doing so it might be interesting if he gave a very slight sketch of its introduction to this country. Previously to the colonization of America, our fir timber was obtained from the countries on the coast of the Baltic, of which Norway, Russia, and Sweden were the first resorted to. The colonization of America, however, soon opened a large and valuable field for obtaining timber of a similar growth, the two Canadas especially yielding large supplies of a very fine quality. More recently a supply of the same kind of timber had been obtained from Georgia and the adjacent States of America, and efforts were then being made to open a trade with California, where was to be found some of the finest red wood ever brought into our market. Fir timber might be divided into three distinct classes, known by the color of the wood—by white, yellow, and red. American spruce deals belonged to the first named class, and were principally used for joists and bearing timbers in common houses as well as for scaffolding in the erection of machinery. There was so much of a very inferior quality of this kind of timber that it was necessary a very practical knowledge of it should be acquired by those under whose direction it was used, as serious accidents frequently happened when it was misapplied. Baltic white deals were wood of a very fine texture, and used principally for the same purposes as the American spruce deals. This timber would not, as a rule, bear so great a load as the American, but it was much less liable to warp from change of temperature. Both these kinds of timber were specially liable to decay if placed in warm and moist situations, fungi speedily forming on them, and causing what was commonly known as dry-rot; and when once this had been commenced, the wood was no longer to be depended upon. These woods were both extensivly used for packing-cases for machinery, and for this purpose was quite as good as more expensive timber.

The next class of timber to which he would direct their attention was the American yellow pine. This timber was imported in logs, and cut up into boards or scantlings in this country; like the white wood, this timber was non-resinous; it was of a fair texture, and when not exposed to damp was durable. It was much used for building purposes, especially for joiners' work that was covered with paint. As a bearing timber it had a peculiar quality —viz: that it retained its form with a permanent load; whereas many kinds of timber when loaded continued to deflect for years, although the load might not be greater than they might safely be required to bear. Unless, however, this wood was properly treated from the log, its valuable quality of retaining its form was materially impaired. The log should be opened and cut into boards in the autumn, and exposed to the weather during the winter; in the spring it should be removed into the drying shed, and thence into a room having a corresponding temperature with that wherein it was to be stored when finished, for at least one month before being worked. On no account should this wood be placed in a stove, as in its removal from a higher temperature it would always be liable to change its form.

There were many qualities of yellow pine, and their quality varied very considerably. Next, referring to the red wood, he said this timber was imported both from America and the Baltic in the form of both logs and deals. There were several varieties of red deals, each possessing its own peculiar character; but all of them more or less valuable on account of their power to resist atmospheric changes and the action of moisture. It was, therefore, much used in engineering works for piles and timber framing exposed to the weather, railway sleepers, and all places where it was necessarily shut out from a free passage of air. It was also less liable than any other kind to dry-rot. The timber imported from Sweden was generally of a very inferior quality and of small size; it was very liable to crack if exposed to the sun, causing what were known as "sunstrokes." The custom at all the ports on the arrival of the timber was to put the log into water to prevent this. The pitch pine imported from the Southern States of North America, Georgia and Florida, was of a strongly resinous character, but had a great tendency to dry-rot, especially if placed in contact with fresh mortar and lime. This timber was, therefore unfit to be built into walls as bearing beams, unless the ends were placed in cast iron boxes, or were otherwise protected so as to allow a free circulation of air around the ends of the beams. Many samples of this timber had a beautiful waived grain, and would take a high polish, and these were selected and used for ornamental joiners' work. One peculiarity in connection with all red-wood was, the varied qualities found in the same log; the lower part of a tree might be exceedingly good, while the upper part might be very inferior. From the remarks he had made, it would be seen how impossible it was to fix any arbitrary formula that would be applicable for calculating its strength, the quality being so variable the same formula would not apply in any two cases. He had tried some experiments on a sufficiently large scale to guide his own judgment, and he found that for a very good and selected sample of Baltic timber the following simple formula for beams might be relied upon: the breaking weight in the centre equalled the product of the breadth, with the square of the depth multiplied by 15, and divided by the length in feet; and for an ordinary sample of timber he usually took the safe load in the centre in tons equal to the product of the breadth, with the square of the depth multiplied by .03, and divided by the length in the feet.

The President then brought his remarks to a close, with the expression of the hope that the subject would be again referred to, and other descriptions of timber dealt with.—*Iron.*

IRON AND ITS CONCOMITANT INDUSTRIES.

Iron, and its manufactured forms, is the very foundation of all industries, for without this, to the people, most precious of all metals, the farmer could no longer till the soil on a scale commensurate with the enhanced requirements of our rapidly-increasing population; nor could our dwellings be constructed; nor could ships be built to accord with the necessities of the times; while everything that is brought into form and shape for general use owes its existence to some labor-saving machine or tool made of iron or steel.

The manufacture of iron calls for an enormous outlay of capital, which requires to be invested in blast furnaces, in order that we may obtain the metal in its crudest manufactured form, and from that condition it is carried on by process after process until a large portion of it reaches the stage of steel, while the intermediate grades answer numberless purposes. To obtain pig iron from the ore, over 700 blast furnaces have been erected throughout the iron producing states (24 in number), which furnaces have a capacity, in the aggregate production, amounting to 4,624,989 tons. The money value involved in this one branch of the iron industry is estimated to be about $94,000,000. To bring iron into the condition required for railroads and general wrought iron work requires (to meet the usual demand) 309 rolling mills, with a capacity of some 2,800,000 tons—the value of all rolled iron for 1873 being $170,350,000.

Such methods as the Bessemer, Siemens, Martin, Nes-silicon, and others are employed to produce steel, the former process showing a conversion of 140,000 tons of pig metal into steel, and representing a money value of $16,800,000.

An immense quantity of iron and steel is absorbed by the railroad interests in the form of rails, locomotives, bridges, cars, etc.

The locomotive works of the United States are great consumers of iron and steel, and are conducted by men of intelligence and large capital—one of the most extensive establishments alone having completed its 3,342d engine in July last. To such a degree of excellence have our locomotive makers carried their work that samples of their skill may be seen on the railroads of Russia, Germany, Austria, Italy, Greece, and Egypt, and all through the states of South America.

Car building is another industry of great magnitude, and a large consumer of wrought and cast iron and steel. The railroad companies, many of them are their own car builders, but there are many works belonging to firms and individuals who make it a distinct branch of business. There are now in use probably 345,000 cars of all kinds in the United States and Canada. Some of our steam railroad cars, especially, are splendid affairs, and our palace cars are astonishing the monarchs of Europe and Asia by the magnificent upholstery, furniture, and general fittings, and the perfection of their mechanical construction.

Thousands of skillful hands are employed in this branch of our industrial interests, and a very large amount of capital is required to conduct it. Car building is, of course, affected by the depressing influence of the late panic, but it will recover quite as soon as any other industry, from the fact that it is a part of the great system of highways without which we cannot progress as a nation.

Car wheel foundries draw very largely upon the iron supply of our furnaces and rolling mills, and is made a specialty of great national importance, employing, as it does, thousands of men, and circulating a very large amount of capital.

Iron pipe and tubing make heavy drafts upon the iron supplies, cast and wrought iron being used in great quantities, and many hands are employed at the

extensive works where the pipes and tubes are manufactured, one of these establishment alone consuming in one yerr 150,995 tons of coal, and giving employment to 3,876 men.

The stove manufacturers with a product of iron work, principally cast, representing a money value of $50,000,000, in addition to the value of the metal consumed, which is estimated at about $7,500,000, must of necessity be among the very best customers of the iron masters or the iron miners, using as they do a total annual consumption of pig iron amounting to the enormous aggregate average of 275,300 tons.

New York is far in excess of any other state in the production of this specialty, Ohio ranking next, and Pennsylvania third.

The iron bridge works call for vast supplies of iron and steel—the great iron bridge of the St. Louis, Kansas City, and Northern railway over the Missouri river at St. Charles alone requiring 7,690,000 pounds in its construction. The industry requires the emplopment of vast capital, and thousands of hands.

The iron ship yards of the United States are large consumers of iron—the great steamship City of Peking requiring 5,400,000 pounds. Our natioual pride has been recently aroused by the new life infused into our iron ship building industry, and it now promises to become such as the nation needs and should sustain.

Steam engine and machine works, guns and pistol works, mowing and reaping machine manufacturers, and builders of iron buildings and railroad depots, use an incredible amount of iron and steel, possess immense capital, and employ many thousand workingmen.

To supply the heavy demands of such industries as we have enumerated calls for an annual production of the raw material to an extent that would have appeared fabulous to our ancestors, who, in Virginia, as early as 1692, turned out a few tons of pig iron. In 1873, the furnaces produced 2,695,434 tons of pig iron, and the rolllng mills furnished 1,730,000 tons of wrought iron.—*Coal and Iron Record.*

AMERICAN IRON.

It is proverbial, at least among the Americans themselves, that they, of all nations, possess in its greatest plenitude the faculty of recuperation. From time to time the American world of business is distracted by financial typhoons; the vessel of state is laid on her beam ends; hotel, and even theatres, reduce their prices; and stern admonitions issue from press and pulpit that the period of piping and dancing is over, and that the—possibly mythical—homely habits of the ancient settler must be revived before there is again health in the land. These lessons are received with very different feelings in various parts of the country. Boston and Providence may perhaps abase themselves in private (for no man has has seen them performing that operation *coram populo*), but gay New York and the great West maintain hopeful, not to say defiant, attitude. Better times must come. Things will get "fixed" at last; and if ruin has been incurred, the boundless resources of a great country will help everybody to begin over again.

This hopeful spirit is not without some admixture of solid truth. A lapse of twelve months has brought about a notable change in the feeling of financial circles in New York. To a less extent this reactionary spirit has made itself felt in other great speculative centers, such as Chicago, St. Louis and Boston. Especially in the direction of railroad securities has renewed confidence been manifested. Shares long neglected have recently met ready purchasers, and there exists that general disposition to invest which is an infallible sign of the revival of business. Under the influence of the late panic, railway property—the *teterrima causa* of the crash of last autumn—suffered most severely; but recent advices show that things were not so bad as they seemed. Stocks have advanced, and chances are in favor of greater activity and heavier investments than have been known for a long time past.

This revival of railway enterprise is not without significance to the iron trade, both of England and of the United States, which latter country has, within the last few years, immensely advanced in the production of iron.

The Americans have a splendid "forest primeval," but the blast furnace is a great devourer, and will thin the surrounding country in an alarmingly short space of time. Possibly, improved railway communication will more than keep pace with the rapid destruction of timber, but the significant fact yet remains that, out of 630 furnaces in blast in 1873, 265 were supplied with charcoal. No charcoal smelting of iron can be long lived; and it is, therefore, clear that, unless increased railway communication be provided, a certain section of the iron industry of the United States will be soon "played out." Vigorus efforts will undoubtedly be made to put other iron producing centers on a level with Pittsburgh, by improving the communication between coal and iron regions; but the truth will always remain constant, that, however rich iron ore may be, it will not pay to carry it too far.

For a long while the American makers had a heavy uphill journey, as, although they were protected by an enormous tariff, and were supplied with a huge home demand, English makers of railway materials swept the market. An unprecedented advance in the price of English coal, and consequently of iron, during the last three years, deprived English makers for a while of their advantage, and, despite dear labor, the American iron works rose last year to a high pitch of prosperity. The delicate conditions of business in the United States failed, however, last autumn to withstand the tension of the financial world, and the American iron and steel trade suffered a paralysis which it communicated in no small degree to the trade of Great Britain. With a keen eye to the wants of the future, the American makers apparently foresaw that the wants of the railway world would be confined to Bessemer steel, and have made great efforts to compete—under the ægis of their duties—with English makers in the production of this important metal. So long as exaggerated prices for fuel and labor prevailed in England, a chance of success remained; but so soon as the period of inflation in England ceased, it at once became evident that steel rails were wanted for America. Barrow-in-Furness is likely to prove for some time a hard nut to crack for all her

competitors in Bessemer steel, be the same English or Welsh, Belgian, French, or American. She has the precise kind of ore required under her feet, and in this particular posseses an undoubted advantage over American rivals. That a country may escape ridiculous smallness by being inconveniently large, is proved by the significant fact that Algerian and Bilbao ores cost at the furnace in America $20 per ton, when they may be bought at Barrow or Cardiff for $6.25. Without "magnificent distances," the superb supplies of iron ore in "the States" would be speedily utilized; but until increased and cheaper railway communication has brought her coal and iron closer together, America will need all her unquestionable energy and ingenuity to compete with England in the world of iron.—*Iron.*

CITY ENGINEERING IN NEW HAVEN.

[CONCLUDED.]

The length of sewers constructed during the year 1873, was 6.981 miles, varying in area of section from a 12 to a 74 inch diameter circle; 226 man-holes, 93 catch-basins, 101 receiving-basins, 45 ft. of 18 in. culvert, 625 ft. of 15 in. culvert, and 4,892 ft. of 12 in. culvert, were also constructed, and plans and profile maps, house connections and assessment maps prepared for each street sewered.

Of the largest size built, 74 in. dia., there were constructed 224.1 ft.; of the smallest, 12 in. dia., 3915.6 ft. No *pipe* larger than 18 in. dia. was used, and more 24 in. sewer than any other size was laid during the year, the length being 6849.1 ft. Of brick sewers 10 different sizes were laid, varying from 20 in. to 74 in. dia., and of an aggregate length of 62 per cent. of the whole length of sewers laid. Of cement pipe 3 sizes were laid of 18", 15", and 12" dia., and of an aggregate length amounting to 24 per ct. of the whole. Of vitrified stoneware or earthenware pipe, only two sizes were laid, of 12 in. and 15 in. dia., and with an aggregate length of 14 per ct. of the whole.

In the contract awarded last year 24 in. egg-shaped brick was substituted for 18 in. pipe sewer, as the difference in cost was but slight, while the former possesses advantages over the latter as regards stability and facilities for cleaning and examination. The proportion of lengths of streets now sewered to total lengths of streets of the city is as 1:4½, the total length of sewers built at the close of 1873 being 26,866 miles. Of these the number of sizes is 21, ranging from 74 in. to 12 in. dia. The longest length laid of any one size is 6.519 miles of 24 in. dia., and the shortest length .016 miles of 20 in. dia. Of the largest size, 74 in., there was laid .043 miles, and of the smallest size, 12 in., 1.949 miles.

One of the most important sewerage works constructed during the year 1873 was the Meadow Street outlet, which is 6 ft. 6 in. wide × 5 ft. 6 in. high, of a section like Fig. 2 in our Supplement to No. 4 of this Journal, but with curved sides, and built on a pile foundation. The crown of this sewer is built in three rings of brick work, and the invert and sides with one ring, bedded in concrete and supported by haunch walls of rubble masonry. This large sewer was built in two lengths, one of 1021.5 ft.. being of a size equivalent in area to a circle 68 in. dia., and the other of 224.1 ft., being of the size mentioned above=74 in. dia.

In one case a sewer crossing the old bed of a creek, was supported upon a timber grillage and haunch walls of masonry. In another case a bad bottom necessitated the use of an artificial bed of concrete and gravel. All the excavations for sewers were, as a rule, in sand and gravel, with occasional cases of quicksand and water. In one case only was rock met with, the "old red sandstone," and it caused much trouble, as it was too hard to pick to good advantage and too soft to blast effectively.

The vitrified pipe laid during the year 1873 were the first of that kind used for a *public* sewer in that City, and was not done by contract but by the city. Though the excavation was in hard gravel its cost per foot, $1.58, was less than that of any other vitrified pipe yet laid in the city of New Haven. The diameter of this sewer was 12 in., length 569.9 ft., and average depth of excavation 8.9 ft.

There are five Tables of Statements attached to the City Surveyor's Report, relating to sewerage matters. Statement No. 5 gives the length, size, and cost of the sewers in each street, with the name of the contractor. Statement No. 6 is a comparison of the contract prices per foot of the various sewers completed during 1871 and 1872, showing the length, average cutting, material of excavation, &c.; and statement 7 gives the same for 1873.

Statement No. 8 gives the size, material, and average contract price per foot of 17 different sizes of sewers, from the large 74" in sewer, to the 12" pipe sewers laid. From this statement we find that the length of 224.4 ft. of the large sewer previously referred to, cost $13.50 for the brick and stonework, and $11.25 for the piling per foot, and that the longer length of the same sewer of 1021.5 ft. costs $12.95 for the brick and stonework, and $10 for the filing. Cement pipe of 15 and 12 ins. dia., cost $2.12 and $1.87 per foot respectively, while vitrified pipe sewers of the same sizes cost $2.53 and $1.93 respectively. Statement No. 9 shows the highest and lowest bids on each contract, with their difference. The competition on the smaller sizes was closer than the larger.

The special Engineering Department was occupied first in establishing a series of bench-marks throughout the ward of Fairhaven, and next in making a map of the whole ward, showing streets, lots, buildings, &c. The method used in running the bench marks was to get two readings of the rod agreeing within .002, and take their mean for a note of the back-sight; a fore-sight was obtained in the same way. These gave a certain difference of level between the two points which was noted. Then when the line was run over again, another difference was obtained in a similar manner. An average of the two was the difference of elevation used, so that the final elevations obtained for benches of any particular line were independent of the results in the column of "reduced levels," as ordinarily written out. The above plan answered well as in connecting the different lines there was in most cases an agreement within .003.

In the prosecution of the survey of the whole ward a system of triangulation was specially desired and adopted.

Upon these triangles the shorter transit lines work in detail, &c., depended and were connected. A base was first carefully measured with a steel tape on the north rail of the Shore Line Railroad track, the measurement being repeated five times, and the prints of changes of grade duly noticed and corrections afterwards made to reduce the base to a horizontal measurement. This gave 2187.763 feet as the length of the base to be used for the purposes of calculation.

Owing to the obstructions formed by the many buildings in the ward, a direct system of triangulation, as ordinarily used, was impracticable, so that as there were two tall church spires in the ward angles were taken to each from the ends of the base line, and then working round each church as a centre two angles in each of the triangles were measured. In taking angles, they were repeated and read seven times, which gave 28 times the angles. One twenty-eighth of the sum of the readings was the angle used in the trigonometrical work for the calculation of the sides of the triangles. This great repetition of angles (28 times) was rendered necessary as the engineer's transit had only one vernier.

The distance between the two churches, as calculated in the course of this survey, was 1723.873 feet, and as determined previously by the Coast Survey, 1723,576 feet, showing a difference of but .297 ft. For verification two bases were measured respectively 1033.93 ft. and 832 ft. in length; as calculated these were 1034.019 ft. and 832.20 ft., showing differences of .089, and .20 respectively.

The river shores were carefully run out, and the line of mean high water determined. The scale adopted for the map was 1-1800th of 50 ft. to 1 in., which makes its size 4½ × 6 ft.

From the Report of the Committee on Harbor Improvements, we find that a survey was made during the year 1873 by the Coast Survey Department, under the chief direction of R. M. Bache, of all the harbor of New Haven, including all wharves and piers, and one or two blocks back therefrom. The triangulation which determined 21 points, chiefly church spires, &c., &c., was finished June 16th. The topography was commenced June 5th, and finished Nov. 6th, and comprised an area of 557.3 acres. The area of the surface covered was 782.3 acres. The shore line of wharves, beach, and marsh, was 23.08 miles. The total shore line, including creeks and ditches, was 27.3 miles.

In the survey three parties were employed, one by the Coast Survey, with assistance from the Sheffield Scientific School of Yale College; the other two by the City, each consisting of one surveyor and three assistants. The instruments used were the theodolite, plane table, steel tape, and telemeter, the latter being employed only where, as in the case of sedge or marsh, extreme accuracy was not required; all other measurements being determined by the steel tape.

The results were all plotted on seven plane table sheets of three feet square each, on the scale of one-twelve hundredth; a map measuring 8 ft. × 5 ft., comprising all these, on a scale of one-twenty-four hundredth. All these maps were made on paper fixed to metal plates in order to exclude errors which might arise from the expansion or contraction of the paper alone.

The total cost of this survey was $6,801.36, or about $8.70 per acre of the surface included in the map.

Among other recommendations the Committee wish to add the hydrography of that portion of the harbor immediately adjoining the City added to the maps upon tne scale of one-four hundredth.

It is also recommended that the lower bar be dredged in a channel 400 ft. wide and 16 ft. deep at mean low-water for which the estimate was as follows:

149595 cubic yards to be dredged, at 30 cts....	$44,878.50
698486 " " " " " 17 cts....	118,727.32
Total cost.....	$163,605.82

We have now concluded our review of the Year Book, and commend all the parties concerned for the careful and systematic manner in which the various Reports are drawn up and arranged.

JOURNAL OF THE RAILWAY ASSOCIATION OF AMERICA.—A circular from the Corresponding Secretary of the Association, Mr. Harry E. Sharpe announces that the second number of the *Journal*, to be issued in December, will contain the following articles:

I.—Special Report on the Freight Traffic of the Pittsburgh, Fort Wayne & Chicago Railway, for the years 1865-6-7-8. By W. S. Shinn, Assistant President Allegheney Valley Railroad Company, formerly Gen'l Freight Agent Pittsburgh, Fort Wayne & Chicago Railway.

II.—A paper furnished by Mr. W. R. Malcolm, Ass't Secretary Board of Trade. (Railway Department), England, to the Joint Select Committee of the English Parliament, in 1872. It describes the systems of management obtaining on the Continental railroads.

III.—A paper furnished to the Committee above mentioned by Capt. H. W. Tyler, Railway Inspector to the Board of Trade. It gives an interesting resume of the history of English Railways; the manner in which their capital was provided; the rates of interest returned; train mileage expenses; variations of cost in working; a retrospect and a glance at the future; railway monopoly; amalgamations; interests of the railway companies *vs.* interests of the public; difficulties of control; company management *vs.* State management; Irish railways, and remarks as to the purchase of the English railways by the State.

IV.—Regulation of Fares and Freights by Legislation; from the Fourth Report of the Massachusetts Commissioners.

V.—A paper on the best means of Preventing Accidents at Railroad Crossings; by J. M. Goodwin, of Cleveland, Ohio.

VI.—Railroad Grade Crossings; a paper read before the Boston Society of Civil Engineers, June 5, 1874, by T. Appleton, C. E.

The Secretary also makes the announcemeut that subscriptions will be received for this, the previous and following numbers of the *Journal* at 75 cents per number. He may be addressed at St. Louis.

Sample copies of "THE ENGINEERING NEWS," will only be sent on receipt of TEN CENTS. To parties sending us a club of ten new subscribers, with ten dollars, we will send the bound volume of the ENGINEER, ARCHITECT, AND SURVEYOR, for 1874.

ENGINEER, ARCHITECT AND SURVEYOR.

A MONTHLY JOURNAL OF PRACTICAL ENGINEERING, ARCHITECTURE SURVEYING, MECHANICS, HYDRAULICS, MINERALOGY, METALLURGY, AND KINDRED SCIENCES.

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CHICAGO, ILL., DEC. 15, 1874.

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Publishers' Announcement.

With this number we propose to close the first volume of our Journal, which will hereafter be issued on the 15th of each month, under the name of "THE ENGINEERING NEWS," and at the low price of ONE DOLLAR per year, postage included, payable invariably in advance. It will be printed on heavier paper than heretofore, and its contents will be more popular in character, and more varied in its range of subjects than in the past.

We think that the proposed changes will commend themselves to our readers. Our new name is quite as comprehensive as the old one, and is suggestive of what our Journal is to be—a record of engineering progress—while our subscription price is placed at such a low figure as to bring it within the means of every person who is interested in practical science.

Our labors during the past nine months have been largely experimental, but although the season has been one of great financial depression to Engineers and Surveyors throughout the whole country, yet we have been so encouraged by the patronage we have received, and the great interest manifested by the profession in our enterprise, that we enter on our second volume with the assurance of a much greater support than heretofore, and of our consequent ability to speedily be enabled to lay before our friends a greater amount of reading matter, and, in time, the best professional Journal in this country.

Although we have adhered pretty closely to our original prospectus, yet some subjects have been left untouched, chief among which is that of Railways, which we propose in future to give a prominent place in our columns. Other subjects now attracting general interest will be discussed from time to time, and a live interest will be taken in all that can materially benefit the professions which we aim to represent, and the public generally. To carry out our intentions thoroughly we need the co-operation of our friends. May we not confidently solicit the active assistance of the Engineers and Surveyors throughout the land, in the shape of their subscriptions, and in communications to our Journal on subjects of general interest, and thus speedily make "THE ENGINEERING NEWS" the most popular scientific paper in this country?

Our subscribers who have paid us a full year's subscription to "ENGINEER, ARCHITECT, AND SURVEYOR," will be credited with $1.50 on this year, and will receive "THE ENGINEERING NEWS" to the expiration of their term of subscription; those of them who remit us fifty cents by the 1st of January will be entitled to receive the full volume of 1875. Will not each of them make an effort to send us one new name at the beginning of the new year; it will double our present list, and compensate considerably for the *premium* of three months' subscription which we allow to each of them by our new arrangement.

Address all communications to "THE ENGINEERING NEWS," or to

GEO. H. FROST,
168 WASHINGTON ST.,
CHICAGO, ILLS.

COUNTY SURVEYORS' OFFICE.

In reply to our questions concerning this subject, we have received answers from most of the public land States, and from some of the Eastern.

In these latter States there is no such office as that of the elective County Surveyor, which is a part of the public land system of the States west of the Ohio river. In Pennsylvania, however, there are elective County Surveyors, who are required to take the oath of office, and be practical surveyors, and whom the County Courts have power to remove for neglect, refusal, or incompetency. All surveyors there are also required to adjust their chains and compasses during each year by a two or four rod standard of measurement, procured for the purpose by the County Commissioners in each County. In Connecticut the Surveyor General, who is appointed by the General Assembly, appoints a deputy in each county, but the County Court may appoint a County Surveyor. In New York there is a law that in order to give testimony in court, regarding a survey, the surveyor must swear that his chain or tape agreed with the county standard at the time the survey was made, which standards are of brass, and kept by the "Sealer of Weights and Measures." In New Jersey any surveyor can make surveys and subdivisions, but is accountable to the court for the accuracy of his work. Highways are laid out by "Surveyors," who are elected each year, but are generally non-professional men, who walk over the road and sign the return made out by the professional who did the work. There are no state laws governing private surveys. The transit is universally used, and the surveyors, as a class, are "intelligent, sharp, quick, and practical."

In the public land States, however, as we have before stated, the office of County Surveyor is a part of the system, and can only be abolished by an amendment to the State constitution. It is elective, the term of office being either two, three, or four years, as each State may deter-

mine for itself. The fees are regulated by legislative enactment, and are, throughout the entire country, so ridiculously small, ranging from three to six dollars per diem, that it is a matter of some surprise that the office should be sought after by able-bodied, intelligent men, who could undoubtedly earn more money in almost any other calling to which they might turn their attention. In some States a small bond is required, but usually there is no responsibility attached to the office. In Indiana, Missouri, and perhaps in two or three other of the States the office is practically a monopoly, or might be made so if desirable by reason of subdivisions and surveys always requiring the signature of the County Surveyor to make them legal, but in the other States surveys and subdivisions may be made by any "competent person," and the County Surveyor's office is practically annulled, if the people did but know it; but in that one fact lies the principal support of the office, as it is generally supposed that a line established by a County Surveyor cannot be altered by any succeeding surveyor, whereas that official having no real power, his surveys are open to examination, and if proved wrong may be corrected. The laws governing the subdivisions of sections, laid down in the statutes of the several States, are almost uniformly in conformity with those of the U. S. Land Department, but as we have stated in a former article, and has been shown by the correspondence published from month to month in this Journal, there is quite a diversity of practice among surveyors, which, as a general rule, is the result of pure and unadulterated ignorance and stupidity. The instruments mostly used are the common and Vernier compasses and Jacob staff, and the huge, clumsy iron chain. Several objections are urged against the use of the transit, the principal one being its unwieldiness as compared with the compass and staff, and the fact that land being so cheap the approximately accurate work of the compass is good enough. Our correspondent from Missouri—whose communication we would like to give entire—objects to the transit, as he travels on horseback and mostly in the most disagreeable season of the year, which is certainly a good reason for preferring a light portable instrument. But we find that the transit and light steel chain or tape are used very considerably, and would undoubtedly be more generally adopted if the emoluments of the business would warrant the expense, and we trust that the instrument makers will yet be able to construct a light, portable compass with a telescope attachment, and at a price that will allow of its extensive adoption throughout the country by the better class of surveyors. We believe it can be done, and that a large demand therefor would be immediately created. The heavy chain is used because it is generally supposed that the light ones will not be able to withstand the rough usage to which they will be subjected by clumsy assistants. Surveyors ought to consider, however, that it is on account of the great weight and unwieldiness of the ordinary chain, and the necessity of a great deal of jerking and pulling to get it straight that creates the hard usage, most of which is unnecessary in a lighter instrument on account of the ease with which it is managed, and the difference in cost is not sufficient to be an objection.

The County Surveyor is generally ex-officio a Commissioner of Highways and Bridges, is sometimes a Commissioner to partition Real Estate, or a Commissioner of Deeds. He is required to make surveys for any parties who desire it and who tender him the legal fees, and he must keep a fair and legible record of all surveys made, in a book prepared for the purpose, and which is at all times accessible to the general public. In Indiana, ten days notice to a resident, and three weeks publication in a newspaper, in case of non-residence, must precede the survey of dividing lines.

The office is considered by some good surveyors to be capable of great general benefit to the public, in inducing uniformity of practice and preventing litigation by creating a belief in the permanency of the official surveys; but it is also generally conceded that, as it now exists, it is an actual damage to community, and by reason of its contemptible income, irresponsibility, and the low grade of intelligence that distinguishes its incumbents, that it ought to be abolished, and the business of surveying thrown open to competition the same as in the professions of law and medicine, or any other legitimate calling in the land.

Our remarks thus far have been general, and based on the information gleaned from our correspondence on the subject. The particular opinions of our correspondents, and the suggestions of some of them, together with the consideration of some of the laws relating to surveys and surveyors, and our own views on the subject, will be given from time to time in succeeding papers. We desire here, however, to thank those parties who have given their time and attention to replying to our questions. Many of their communications are quite voluminous, and all are full of valuable information and suggestions, which we hope in time to lay before our readers in as condensed a form as a proper statement of all the matters will allow.

PERSONALS.

S. S. Greeley, City Surveyor, has been appointed Village Engineer of Hyde Park, at a salary of $3,000 per annum. A better appointment could not be made.

Mr. S. W. Burnham, of this city, a gentleman who has given a good deal of attention to the study of astronomy, has received a letter from the Royal Astronomical Society, of London, informing him that he has been elected a Fellow of the Society. This is a well-merited compliment worthily bestowed.

The latest wise man of the East who is coming to instruct heathenish Chicago in the way she should walk is Mr. Egbert Viele, Sanitary Engineer of New York. Mr. Viele is considered one of the best sanitary engineers in the world, and he has been jointly invited by the Board of Health and the Board of Public Works to give a lecture on sanitary drainage and pavements, and also to make some suggestions to the City authorities as to the best methods of preventing the spread of disease.

CORRESPONDENCE.

G. H. R., MONTICELLO.

Loomis' Practical Astronomy, $2. American Ephemeris, and Chauvenet's Spherical Trigonometry, $1.75. Can be had at this office.

ELK RAPIDS, MICH., Oct. 21, 1874.

MESSRS. EDITORS:

The article in September number, "Surveying in Chicago," calls attention to the different standards of measure, and the careless use of improper chains. I believe you cannot give too much space to this subject, as it concerns every surveyor. It is a very difficult matter to have chaining done correctly, and fully as difficult to get absolutely correct and reliable standards. I think the recommendation laid down in some of the surveying books, catalogues, &c., (Gurley), to establish monuments by which to compare a chain after it has been used, is faulty, from the change which may take place by temperature, &c., with any such monuments. The correct method is to have an extra standard chain *never to be used* except for comparison of other chains, and at given temperature. Such standars should be provided by law, at each State Capitol at least, and *all surveyors* REQUIRED to compare. I venture the assertion that in this State not one surveyor's chain in fifty is correct, but who shall say which are right?

G E. S., Co. Surveyor.

ITHACA, N. Y., Nov. 23, 1874.

MESSRS. EDITORS:

I wish to find out through your columns what is considered close leveling by your readers. Opinions vary among my small acquaintance from 0.01 ft. (one-hundredth) to 0.1 ft. (one-tenth) in a circuit of 10 miles. The best I ever did was three miles and back with a closing test on original B. M. of 0.067. Yours truly,

F. A. C. Civil Engineer.

G. N. B., POPLAR BLUFF, MO.:

The ¼ section corner of Sec. 31 on the South line and of Sec. 1 on its East line, were set by the U, S. Deputy Surveyor in running the Township Boundaries; it is not necessary therefore to set the North and West ¼ corners of cection 6, as they are determined by the corners already set.

CIVIL ENGINEER'S CLUB OF THE N. W.

The December meeting was held on the evening of Tuesday, the 1st inst., at the Club Rooms, 145 Clark St., commencing at 5.30 o'clock. The President, E. S. Chesbrough, occupied the chair. There were present nineteen members of the Club, besides Capt. Wm. H. Dall, of Alaska fame, and Chas. Hermany, Chief Engineer of Louisville Water Works, as visitors.

After the minutes of the last meeting were read and adopted, a paper on "Ancient Engineering" was read by E. L. Billings, after which W. M. R. French, of the firm of Cleveland & French, Landscape Architects, read a paper on "The Telemeter Attachment to the Surveyor's Transit," which we print in full below, and to which Capt. Dall added, as the results of his own observations, some very interesting remarks upon the Telemeter, and its uses in coast surveying.

Gen. W. L. Smith then brought to the attention of the Club a memorial to Congress, requesting the U. S. Government to institute a series of tests and experiments to determine the qualities of American iron and steel, and asking for the endorsement of the Club. The memorial was read, after which the Secretary, L. P. Morehouse, being appointed a committee to draft a resolution, presented the following:—"*Resolved*, That the Civil Engineers' Club of the Northwest, having heard the memorial to Congress on the subject of tests of American iron and steel, prepared and adopted by the American Society of Civil Engineers, heartily endorses the same, and desires to express the deep interest it feels in the success of this effort to secure that accurate knowledge of the strength and characteristics of American materials, the need of which the members of the Club have keenly felt while engaged in works requiring their employment." Adopted.

A vote of thanks was then given to Messrs. Billings and French, for their papers, and to Capt. Dall for his remarks, following which a vote was passed that hereafter no "vote of thanks" would be given to members for regular papers read before the Club.

The meeting then adjourned.

Mr. W. M. R. French's paper read as follows:

I am not clear with regard to the approved use of the terms *Telemeter* and *Stadia Instruments*; but, supposing the instrument I have used at any rate to belong to the general class of Telemeters I have designated it by that name.

There is a long series of articles on Telemeters in volume XIV. and XV, of "Engineering," but they relate almost entirely to instruments intended for military purposes, and give very inadequate notice of the only instrument which promises to be of use to the ordinary surveyor.

I owe the suggestion of applying the Telemeter to ordinary work to Mr. D. Farrand Henry, formerly of the Lake Survey, now Chief Engineer of the Detroit water-works, who mentioned to me three years ago that if he were about to make preliminary surveys for railroads or other purposes, he should use this instrument, asserting his belief that distances could be measured with it as nearly accurate as they usually are with the chain, and with much greater speed and economy. Finding that the telemeter attachment could be added at a trifling expense to an ordinary transit, I have made trial of it, and for the last two seasons have used it for all my topographical surveying, with results so excellent that I think them worth laying before the Club, the more so as it appears to be very little known or used.

The Telemeter attachment consists simply of the addition of two extra horizontal cross-hairs to a common transit instrument, which appear in the field of sight equi-distant above and below the usual horizontal cross-hair. These extra cross-hairs are set upon a diapraghm of their own, and admit of an adjustment increasing or diminishing their perpendicular distance from each other and from the central wire.

The instrument (an engineer's transit) before you is of Young's make, and has been satisfactorily fitted with telemeter wires by Mr. Kratzenstein (No. 157 State Street.) A rod plainly divided into feet, tenths and hundreths, completes the equipment. I prefer the simple graduation of the rod (illustrated in this rod), and use the same rod for levelling. Distances are measured by setting the rod perpendicularly upon or beside the object to be observed, and reading through the instrument the number of feet and decimals of feet intercepted between the Telemeter wires, which are adjusted so as to intercept a foot of the rod at 100 feet of distance, two feet at 200 feet, &c: A ten feet rod thus serves to measure distances up to 1000 feet, or using the centre wire, up to 2000 feet, a greater distance than is often requisite for my own uses.

The limits of the accuracy of the instrument are plainly determined by the power of the telescope. My own experience with surveyors' glasses, judging from level glasses (ordinarily more powerful than transits), leads me to believe that it is not practicable to read a target rod nearer than to two or three thousandths in 200 feet. With the double wires of the Telemeter the workman is liable to twice this error of reading, or say 5-1000 in 200 feet, though the chances are favorable to his hitting nearer than this. This indicates a liability to an extreme error, in reading the distance, of 5-10 in every 200 feet, or a foot in every 400, which is not far from my observation of the actual results with distances of that amount and upwards. That is to say the surveyor strikes the nearest foot, but occasionally gets a foot out, and once in a while two feet.

I do not remember ever having had an error of *three* feet in distances under 1000 that could be fairly attributed to defects of the instrument. In practice I have not found the error at all proportionate to the distances, but the actual error is about as great for distance of 200 feet as for 800. I regret that I have not found time to make careful tests and observations of the operation of the instrument. I take at random from my note-books the following list of observations with the Telemeter, compared with meas-

urements of the same lines with a steel tape. It ought to be premised that for my purposes I have no occasion for great accuracy, correctness rather than extreme nicety being required.

The following are from a survey of the private estate of Buckingham Sturges, Esq., at Geneva Lake.

Line.	Tel. Meas't.	Tape Meas't.	Line.	Tel. Meas't	Tape Meas't.
D–E	244	244.08	I–J	266	267.3
M–E	468	467.78	E–F	429	428.8
J–E	468	467.78	F–H	528	528.4

The Telemeter instrument of course measures actual distances, without reference to distance of level. Instruments especially constructed for the purpose, are provided with micrometer screws with which to elevate or depress the telescope, and from the reading of which, compared with the observed distance, the difference of level and the horizontal distance may be obtained. The instrument is also obviously subject to a second error, when there is a difference of elevation consequent upon the line of sight not striking the perpendicular rod at right angles.

Tables for the correction of these errors, or rather of this compound error, have been published, though I have not seen them.

For ordinary topographical purposes, with the instruments which I have used, such tables would be nearly useless, for two reasons; First, because other sources of error are greater than these; and second, because in all ordinary cases a quick eye will estimate differences of level nearly enough to correct the Telemeter to the nearest foot.

An elevation of 14 or 15 feet is requirel to make 100 feet read 101; an elevation of over 20 feet to make 200, 201; nearly 30 feet to make 400, 401; &c. Such quantities can be estimated by inspection, and I have found this method satisfactory enough, taking the additional precaution read the lesser foot in case of doubt.

I do not trust my Telemeter for steep embankments, &c., but do not doubt that with proper arrangements it can be satisfactorily used.

It will be seen that these results—accurate in general within a foot in 500—are sufficiently correct for the purposes of general topography, indeed as accurate as any method can be for the location of such indefinite objects as the edges of bodies of water, or of woods, the top of a hill, the thread of a valley, &c.

The results are as near as they can be platted upon a scale of 100 or 200 feet to an inch. For boundary lines, base-lines, or measurements for engineering structures, the Telemeter is only useful as a check upon actual measurements.

It is especially useful for measuring across water, meandering shore lines, &c. On one occasion, in Minnesota, my men surveyed in about two hours a little, winding, irregular lake, by setting upon a single prominent point, which it would have taken perhaps two days to have surveyed equally well by bases and offsetts.

My own surveys are usually incidental to the preparation or execution of landscape gardening plans. The adoption of the Telemeter revolutionized at once my methods of preliminary surveying. I had before practised the ordinary method of surrounding the tract with base-lines, taking the angles with the transit and measuring the bases with the steel tape, testing and platting the work by traverse, and filling in the interior topography by means of supplementary bases and cross-sections. With the Telemeter, my practice is to choose a base line, or if necessary a series of two or three bases, in the open and accessible parts of the land, setting stakes at intervals of 300 or 400 ft. so as to have a stake in sight and within a thousand feet of every point I desire to locate either in the boundary or the interior of the tract. These base-lines I survey with transit and tape, excepting in very rough work when I have sometimes trusted the Telemeter for the whole. All the rest is done with the Telemeter, turning the angles from the bases and measuring the distances by observation.

The notes are of the simplest form, thus: "Set the Telemeter on Stake A, Sight Stake B—Turn Right (or Left); at so many degrees and such a distance the object observed." The columns of observations on each station follow.

Only one skilled workman, the man at the instrument, is essential, but the most rapid and economical work is done by employing besides the rodman a competent man to use the instrument, the head of the party directing the rodman and keeping the notes. For desultory work like mine, the possibility of getting along without skilled hands or of employing any intelligent person to keep the notes, together with the simplicity of the platting are among the principal recommendations of the instrument.

I use for platting, after the bases are accurately put upon the paper, a large engraved paper protractor which is pinned down with thumb tacks upon each station successively, and used, with a scale, very much as the Telemeter itself is. I cut out the inside of the quadrants of the protractor for convenience and when distances come upon the bars prick them through, Of course any tyro can do the platting.

I do not hesitate to say that the expense of my preliminary surveying has been reduced to less than one half simply by the adoption of the Telemeter Instrument.

MEMORIAL ON TESTS OF AMERICAN IRON AND STEEL.

The following is the Memorial referred to in the Report of the meeting of the Civil Engineers' Club of the North-West.

To the Honorable, the Senate and House of Reprentatives of the United States of America, in Congress assembled:—

The undersigned respectfully represent that they are members of a Committee duly appointed, in accordance with the following resolution, passed by the American Society of Civil Engineers, in Convention assembled at Chicago, Illinois, June 6th, 1872.

"*Whereas*, American engineers are now mainly dependent upon formulæ for the calculation of the strength of different forms of iron and steel, not based on experiments upon American materials and manufacture; and

"*Whereas*, these differ greatly in many of their characteristics from those of foreign production, both in their nature and forms; therefore

"*Resolved* that a Committee of five be appointed to urge upon the United States Government the importance of a thorough and complete series of tests of American iron and steel, and the great value of formulæ to be deduced from such experiments."

Your Memorialists, in the discharge of the duty imposed upon them by the foregoing resolution, would respectfully set forth facts and considerations in relation to the uncertaint es connected with the manufacture and use of iron and steel in the United States, as follows, from which it is earnestly hoped, that the importance of the experiments proposed, and the value of the formulæ to be deduced from them, may be apparent.

Iron and steel are now used for so many purposes, which they serve so much better than any other available materials, that not only the comfort and convenience of the people—but the safety of life and property depends greatly on a correct knowledge, and a proper use of them. So intimately are these metals associated with nearly all the most valuable industries, that their consumption by a community has become at once a means and a measure of its civilization.

As the uses of iron and steel have multiplied and extended, so also have the processes by which they are made and wrought become more varied and intricate, and the forms they are caused to assume, more numerous and complex. Many of these forms and processes are new; the results in this country have not been so tested and reported as to give the mechanic, the architect and the engineer the accurate knowledge of strength and other characteristics which is indispensible to judicious use. The variation in quality of these materials, as made and sold, is due to so many causes. that only an exhaustive series of experiments can determine the different characteristics and reveal the conditions which produce them.

Among the most obvious of these causes may be mentioned, the kinds and mixtures of the ores and fuel employed and the different methods of their treatment in the production of pig-metal. These in the United States are unlike those of other iron producing countries. The products of the several methods of making iron and steel also differ in their qualities. But it is only where iron and steel have been wrought into shapes required in actual use, that the peculiar characteristics of each are fixed and established. They are melted, cast, hammered and rolled, chilled, tempered, case-hardened and annealed, welded, upset, drawn, bent and twisted, planed, turned, drilled, sheared, punched and riveted, and are otherwise variously tortured in the process of manufacture and use; they are worked into a great variety of shapes and dimensions, instanced by the finest needle and the enormous shafts and bed plates of the largest marine engine.

Yet, strange as it may appear, American engineers, architects, manufacturers and mechanics, are dependent for the calculation of the strength of iron and steel in most of the forms used, on English materials exclusively, although it is well known that domestic iron and steel, as actually employed, differs so greatly from foreign, that such formulæ give, at best, but rudely approximate results.

In the United States no comprehensive series of tests have been made, or rule determined, by a competent and disinterested authority which can be accepted without caution in computing the strength of these American materials. Therefore it is not strange that accidents resulting from the breaking of parts of machinery, the failure of bridges, or the fall of buildings constantly take place, sometimes with great loss of life and property. It is more remarkable that such are not more common.

No one individual or company can well afford to provide the expensive machinery required to test the parts of iron structures of full size, and if the machinery were supplied, these parts are too costly for individuals or companies to destroy in making tests, and the statements of results thus obtained would not be received with entire confidence. Often from the behavior of small pieces under test, an analogy is traced and accepted, which may or may not exist. In certain cases, manufacturing companies do test pieces of the full sizes used. Valuable experiments are also sometimes made by individuals or corporations preparatory to the erection of very important works.

Such tests of iron and steel have been made by the Engineer and Ordnance Corps of the United States Army, which, by the accomplished officers of these corps are usually in progress; the value of the results obtained is recognized and appreciated, but the means employed in the varied and disconnected efforts are inadequate, and the facts developed and rules derived from them have not been so collated and reduced as to be accessible to the general public.

Your Memorialists would further respectfully set forth, that it will require a very considerable expenditure of money to provide a place and machinery suitable to make an exhaustive set of tests of American iron and steel and of other materials, as stone and wood, which enter largely into construction. The services of able, scientific and practical men will be required, and years of time must be spent by them in the investigations now so urgently needed.

In most of the iron producing countries of the world, tests more or less thorough, of the qualities of iron and steel there produced have been made—so that not only are the people of each country well advised as to the the correct use of their materials, but the qualities of such are, at the same time, made known throughout the world, and thereby, in every instance, the national wealth has been largely augmented.

The Commission appointed in 1847, by the British Government, to inquire into the application of iron to railway structures, spent two years in investigation, and made a report which ever since has been the basis of practice in the use of iron for railway purposes, not only in England, but almost in the whole civilized world. In France, the government has shown marked interest in encouraging engineers, manufacturers and others to test all materials that enter into construction, by permitting such tests to be made at national cost at the various schools of instruction, which are supported by the state. The value of these impartial examinations into the strength and constituents of materials officially certified to, cannot be over-estimated. The various tables of strength of materials by Mons. Tresca and others are well known. In other countries on the continent of Europe, much from time to time, has been done in this direction under government supervision or by state aid—though not so regular as in France.

In countries where such thorough investigations have been made, and the results given to the public—any great mistakes in the application of the materials tested are without excuse. But in the United States, through want of the precise knowledge which the experiments will develop that your Memorialists earnestly ask shall be made, even natural constructive talent, of a high order, is frequently a fault, and the result is either excess and consequent waste of material, or, what is still more disastrous, weakness where strength is essential.

It is more than probable that our government itself, as a large consumer of iron and steel, wastes in over-sizes and ill-proportioned forms, enough iron annually to defray the entire expenses of the investigations asked; while it is not at all certain that public buildings and machinery are as safe as they might be made at less expense, with the thorough knowledge of the materials employed in their construction, which your Memorialists respectfully urge it to be the duty of the government to obtain.

W. Sooy Smith,	Geo. B. McClellan,
John G. Barnard,	Robert H. Thurston,
Jamfs B. Eads,	Charles B. Richards,
Albert Fink,	Otho E. Michaelis.

Back Numbers of the "Engineer, Architect, and Surveyor.—Less than one hundred *complete* files of the Engineer, Architect, and Surveyor, remain; these we will have bound in paper covers and offer for sale at one dollar and fifty cents per volume of 168 pages.

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Capt. Wm. H. Dall's Remarks at the Civil Engineers' Club.—Capt. Dall has used the Telemeter for four years in surveys on the coast and interior of Alaska; his rod was even more simple than Mr. French's, and he found that he could depend on his surveys being almost accurate, and in some cases much more so than if measured with the chain or tape. On rocky shores the telemeter was invaluable, and in a few months he had, with the assistance of a common sailor as rodman, made surveys that by the ordinary methods would require fully five years to complete. He discovered after a time that for correct results an accurate focus was necessary, and to every observation the following correction for error in measurment was to be added, viz: to the distance of the eye piece from the object glass add the distance of the object glass from the diaphragm, which in the case of his instrument was exactly one foot.

[We consider this subject of surveying with the Telemeter to be a very important one, and worthy of careful investigation. We propose to test the method ourselves, and will be very much gratified to receive communications from any engineers or surveyors who have given it their attention.—Ed.]

LAW AND LEGISLATION.

An abstract of decisions of the Supreme Court of the United States and of the courts of the various States in the Union upon questions relating to boundaries, surveys, etc.

194. Where the owner of suburban lands lays them out into building lots, with intersecting streets, and conveys the lots by deeds describing the boundaries as running to and on such streets, the grantees will take the fee of the land in front of their respective lots to the centre of the streets; and if the corporation order such streets to be shut up, and the grantees enclose them, the grantor cannot maintain ejectment for the same. Hammond v McLaughlin, 1 Sandf. Sup. Ct. Rep. (N. Y.), 323.

195. Where a specified tract of land is sold for a gross sum, the boundaries of the tract control the description of the quantity it contains, and neither party can have a remedy against the other for an excess or deficiency in the quantity, unless such excess or deficiency is so great as to furnish evidence of fraud or misrepresentation. Voorhees v. De Meyer, 2 Barb. Sup. Ct. Rep. (N.Y.), 37.

196. Where a deed described the land conveyed as commencing at a known monument, and running east one hundred and fifty-seven feet to a stake and stones, but, at the time the deed was executed, there were no stakes and stones there, the same having been entirely removed some years before, so that no vestige of them could be discovered, it was held, that the line could not be construed to run to where the stake and stones formerly stood, but that the courses and distances must govern. Seaman v. Hogeboom, 2 Barb. Snp. Ct. Rep. (N. Y.), 215.

197. Where a line in a land patent is described as running "east northeast up" a certain creek, the line is not necessarily confined to the meanderings of the creek, but merely indicates the general direction thereof But when the patent proceeds to say, after giving all the other lines, that the land is "bounded north with the creek," this fixes the line of the creek as being the boundary of the land. Budd v. Brooke, 3 Gill. (S,C.) 198.

198. Where a line is described as running in a certain distance, to a particular monument, and that monument has disappeared, and its place cannot be ascertained, the course and distance, in the absence of other controlling words, must govern. *Ibid.*

199. Where in a patent for land, a monument is mentioned which has disappeared, and which is described as being "upon a point of the mouth of the creek," the latter words are not sufficient, in the absence of any evidence of the spot where the monument stood, to control the force of the courses and distances named in the patent. *Ibid.*

200. Unintelligible plats and locations, which cannot be understood by the Court or Jury, should be rejected when offered in evidence to determine the boundaries of land. *Ibid.*

201. Boundaries may be proved by parol, but only in conformity with the surveys, or some valid agreement or partition. May v. Baskins, 12 S & M. (Miss.), 428.

202. The original surveys by which the government sold its land and conveyed it to the purchaser, establish the rights of the parties as to the boundaries. No line which will vary the rights thus acquired, can afterwards be established, without consent of all parties. *Ibid.*

203. So, in trespass against the defendant for removing the plaintiff's fence, proof that by the government surveys the fence was on defendant's land cannot be affected by proof of other surveys, not conforming to the government surveys. *Ibid.*

204. On an indictment for a nuisance in obstructing a highway, parol evidence of the existence of certain marked trees and monuments, not called for in the survey of the road, is inadmissible to establish, by these marks and monuments, a line of the road variant from that called for by the courses and distances, by which alone such line is designated in the survey. Moore v. People, 2 Doug. (Mich.), 420.

205. A prior certificate of entry, on which no patent has issued, gives a better title in equity, than a subsequent certificate on which a patent has issued. and such patent title will be set aside in equity, at the instance of him who first entered the land. Hester v. Kembrough, 12 S. & M. (Miss.), 659.

206. So, if the patentee in each case has recovered a judgment in ejectment against the first enterer, equity will enjoin all proceedings under the judgment.—*Ibid.*

207. Where the same grantor conveys to two persons, to each one, a lot of land, limiting each to a certain number of rods, from opposite known bounds, running in a direction to meet, if extended far enough, and by a measurement the lots do not adjoin, when it appears from the same deeds that it was the intention they should, a rule should be applied, which will divide the surplus, over the admeasurement named in the deeds, ascertained to exist by actual admeasurement upon the earth, between the grantees, in proportion to the length of their respective lines, as stated in their deeds. Lincoln v. Edgecomb, 28 Maine, 275.

208. A parol agreement, fixing a dividing line of land and ascertaining its position on the ground, with possession immediately following, is conclusive on the parties, and cannot be controverted; and such an agreement is not within the statute of Frauds. Lindsay v. Springer, 4 Harring. (Del.) 547.

209. The grantee of land, bordering on a stream not navigable, takes to the centre of the stream, unless there is an express reservation confining him to the margin; and he is entitled to recover damages against a party, who, to his injury, diverts the water passing over his land from its natnral channel. Canal Trustees v. Haven, 5 Gilman (Ills.), 548.

210. A parol agreement respecting the boundary between adjacent lands will not be held binding when there was a previous definite boundary, and where the party who sets up such agreement had not, at the time it was made, a valid title to the land claimed by him. Lewallen v. Overton, 9 Humph. (Tenn.), 76.

211. Where land is designated with certainty, in a deed, by definite boundaries, the further description of it, as "the land on which A resides" may be rejected as merely incidental. Bratton v. Clawson, 3 Strobh. (S. C.), 127.

212. Where a person purchases land by metes, and bounds said to contain a certain number of acres, more or less, he is entitled to all the land within the limits, whatever the number of acres may be. *Ibid.*

213. Commissioners were appointed to divide a tract of land between the joint owners. They fixed the corners of the dividing land, and intended that the division should be by a straight line from one of the corners to the otner; and the line was so described in their report, and so laid down on the plat which they returned to Court. In fact, however, the land being covered with a thick wood, the line which they marked was not straight. In cross actions of ejectment and trespass between the owners of the two tracts, it was held, that the true division line was the line as it was intended to be, and not the line marked on the land. Smith v. Davis, 4 Gratt. (Va.), 50.

214. Where a deed conveys land by well defined boundaries, a parol agreement, made before the execution of the deed, that other adjoining land, beyond these boundaries, shall be included in it, or an agreement after its execution, that it shall extend, so as to include other adjoining lands, cannot have the effect to embrace such other lands within the deed. Tasley v. English, 5 Gratt. (Va.), 141.

215. A plat annexed to a grant, cannot control the calls of the grant, where it does not lay down a natural boundary therein called for. Library Fund v. Clark, 9 Ired. (N. C.), 58.

216. Where a grant began on a lake, and thence ran south a certain distance, then again west a certain distance, then north a certain distance, thence east a certain distance, "with the windings of the lake water to the beginning," it was held, that although the distance mentioned in the third line should fail before the lake was reached, yet it must be continued in a direct course towards the lake, *Ibid.*

217. Quantity, generally, cannot control a location. Amick v. Holman 13 Shobh. (S. C.), 122.

THE pavement of London covers nearly 4,000 acres, two-thirds of which consists of what may be called mosaic work, done in the plain style, and the other third of smooth flagging. The paved streets number over 5,000, and exceed 2,000 miles in length.

AN ACT TO REVISE THE LAW OF ILLINOIS IN RELATION TO PLATS.

[*Approved March 21, 1874. In force July 1, 1874.*]

[Sections 1 to 5 were published in the April No. of the ENGINEER, ARCHITECT, AND SURVEYOR.]

VACATION OF PLATS.

SEC. 6. Any such plat may be vacated by the owner of the premises at any time before the sale of any lot therein, by a written instrument declaring the same to be vacated, executed, acknowledged, or proved, and recorded in like manner as deeds of lands, which declaration being duly recorded shall operate to destroy the force and effect of the recording the plat so vacated, and to divest all public rights in the streets, alleys, and public grounds, and all dedications laid out or described in such plat; when lots have been sold the plat may be vacated in the manner herein provided by all the owners of lots in such plat joining in the execution of such writing.

7. Any part of a plat may be vacated in the manner provided in the preceding section, and subject to the conditions therein prescribed—*Provided*, such vacation shall not abridge or destroy any of the rights or privileges of other proprietors in such plat; *and provided further*, that nothing contained in this section shall authorize the closing or obstructing of any public highway laid out according to law.

8. When any plat or part thereof is vacated, the recorder in whose office the plat is recorded, shall, upon the recording of such vacation, write in plain letters across the plat, or part so vacated, the word "vacated;" and shall also make a reference on the same to the volume and page in which the instrument of vacation is recorded.

9. Wherever any highway, road, street, alley, public ground. toll-road, railroad, or canal is laid out, located, opened, widened or extended, or the location thereof altered, it shall be the duty of the Commissioners, authorities, officers, persons or corporations, public or private, laying out, locating, opening, widening extending, or altering the same, to cause a plat thereof showing the width, courses and extent thereof, and making such reference to known and established corners or monuments, that the location thereof may be ascertained, to be made, and recorded in the office of the recorder of the county in which the premises taken or used for the same, or any part thereof, are situated, within six months after such highway, road, street, alley, public ground, toll-road, railroad or canal is laid out, located, opened, widened or extended, or the location thereof altered; and when any highway, &c., is vacated, the order, ordinance, or other declaration, vacating the same, shall be in like manner recorded. This act shall not be construed to alter or affect any law specifically providing for the recording of any such plat, or to require the same to be recorded sooner than is so specifically provided; except that any requirements to record such plat in any other place than is provided herein shall not excuse the parties from complying with this act. Whoever shall refuse or neglect to comply with this section shall forfeit $25, and the like sum for every month he shall continue in such refusal or neglect after conviction therefor, to be recovered before any Justice of the Peace of the County, in the name of the County, one half to the use of the County, and the other half to the use of the person complaining.

10. Whenever it shall come to the knowledge of the recorder of deeds of any county, that any of the provisions of this act have been violated, it shall be his duty to notify the state's attorney of the fact, and the states attorney shall immediately institute suit, and prosecute the same to final judgment against the person offending.

ACADEMY OF SCIENCES.

The regular monthly meeting of the Academy of Sciences was held last evening at their rooms, No. 263 Wabash Avenue, the President in the chair.

When the minutes af the November meeting were read, Mr. A. E. Ebert desired to correct an error in them. Prof. Delafontaine, he said, was represented as claiming to be the discoverer of the effects of the infusion of hydro-chloral with the blood of animals. He did not think the Professor made such a claim.

Prof. Delafontaine replied thot the minutes correctly represented the remarks he made, He stated that he did mrke the discovery.

Mr. Ebert said that scientific journals set forth that Mons. Tirrens, a French chemist, made the discovery a long while ago.

The President interposed, saying that the question of priority as to the discovery was not properly before the Academy. A discussion on that question would be proper at another time. The question before them was whether the minutes were correct as to what occurred at the last meeting.

A member moved the adoption of the minutes, and the motion being put was agreed to.

The Secretary then read the following list of donors since the last meeting: H. C. Freeman, Cobden, Ills.; Lieut. O. W. Newell, Annawan, Ills., Samuel Johnson, Chicago; Prof. J. H. McChesney, O. W. Wescott, the Hon. J. D. Caton, J. W. Velie, and Edmund Norton, Chicago, who donated a fossil rush from Willmington, Ills. Donors to the library: the Smithsonian Institute, several foreign societies, and H. W. Boyd.

Reports of Committees were then called for, and, there being no response, Prof. Delafontaine desired the privilege of vindicating himself. The President replied, saying that an opportunity would be afforded him when miscellaneous business was reached.

Mr. E. Colbert stated that he wished to call the attention of the Academy to the fact that the present meeting was held at one of the most important scientific epochs in the world's history. He said:

The transit of Venus over the sun's disc, as seen from the earth, occurs to night; it is now in progress. At two minutes before 8 o'clock the planet impinged on the northeastern edge of the sun, as seen by observers to whom the phenomenon is in the zenith; and it will pass off at the northwestern edge about 36 minutes after our midnight. At the present moment very many scientific eyes are watching the little black speck on the surface of the sun. More than a hundred telescopes are pointed at it, and scores of trained observers are reading off the distances of the spot from the nearest point of the luminous disc, as determined by the micrometer. Several dozens of sets of photographic apparatus have been examined and adjusted for the last time, and are now being used at a rate which ticks off a photograph of the God of Day for each second of time. The heliometers are being set and read, and set and read again, to the barely audible ticking of the chronometer. In short, the work for which so many men have been in training for months past, for which so many instruments have been made, so many journeys taken, so much money expended, and so many calculations and speculations indulged in, is now being performed.

The sun and the planet are both below our horizon. They will be below it till after the transit is over. Not only we, but the whole of the American Continent, is excluded from a view of the phenomenon, except that those who occupy the western tip of the Alaskan peninsula may view the beginning of the transit just before the sun sets, and see him sink beneath the waters of the Northern Pacific as the shade of Memnon was called away just it had begun to reveal the secrets of the Egyptian pyramids. It will also be visible, for a few moments only, from Cape Horn; but neither of those points will be available for purposes of scientific observation, because the refraction of our atmosphere near the horizon distorts the image of the sun too much to permit of accurate measuremsnt.

The nearest of the observers is, therefore, several thousands of miles distant from Chicago. Many of them are not far from our antipodes. But this very fact rather adds to our interest than diminishes it. We cannot join them in watching the gradual stealing of that little dark speck across the face of the sun; but we can follow them in their anxieties and efforts to obtain the quantities which will enable astronomers to solve the problem of the nineteenth century. Nay, our interest is even increased by distance, as the fond parent thinking of a child lying sick in some distant city, is tenfold more anxious than if by the bedside of the loved one. We may picture to ourselves faintly the intense disappointment of those who have sailed around a large part of the globe only to find themselves clouded at the critical moment, and love's labor entirely lost. Neither can one forget the possibility that not a few of the observers have awaited the event with trembling expectancy which has unstrung their nerves, and rendered them incapable of watching the phenomenon with that philosophical calmness that is so essential to accuracy in the result deduced from their work.

As a professedly scientific body, which recognizes only the operation of natural law in the causation of natural phenomena, we cannot pray that

the observers may be blessed with calm minds and clear skies; and even if we did not so feel, seeing that the transit is already partially over, we may say that "it is past praying for" But we cannot help wishing them success; and that so strongly that the effort will be scarcely less than devotional, if we accept the definition that—

Prayer is the soul's sincere desire,
Uttered or unexpressed;
The motion of a hidden fire,
That trembles in the breast.

I had not proposed to weary the Academy with a dissertation on the way in which the transit will be used to solve the grand problem of the sun's distance, nor to speak of the scientific advantages that will ensue, if the most sanguine expectations are realized. The subject has been already "done to death" in the newspapers and magazines; and I scarcely know whether to be more astonished at the intimate knowledge of the matter displayed in some of the articles I have read, or the lamentable ignorance of the first principles of astronomical science which has cropped out in the dissertations of some who have written the most confidentially about it. Between the two sets of writers I am left with nothing to say that is new, and could scarcely say a foolish thing about it that has not already been put in print. But I have been requested to explain the phenomenon.

[The speaker here referred to a series of diagrams which he had prepared and occupied about half an hour in showing in a very simple manner how the observations will enable astronomers to find the length of the unit of the star measures. He continued]

The results of the patient watchings of to-night will not be known for several months; perhaps not in a year from now; and they will probably be affected with a larger possible error than is generally anticipated. It will be some weeks before the telescopic measures taken at all the stations can be known, even if transmitted by telegraph, because many of those stations are far removed from any ocean cable at present in existence. At many of the stations the chief dependence will be on photographic views, and the "negatives" cannot be transmitted by means of the lightning flash; they can only be carried by the slower steam to the observatories where they can be submitted to measurement with the micrometer. Then all the results obtained at separate stations must be compared, and many laborious calculations be made before the value of the solar parallax can be known.

I have called your attention, at former meetings, to the difficulties which will be encountered in the attempt to reconcile these observations; difficulties arising from, 1, the irregular shape of the earth, which is not a true oblate spheroid; 2, the irregular contour of the sun, his surface being in a state of perpetual commotion; and, 3, the errors of observation, which may be regarded as an extended kind of "personal equation." Summing the probable averages of these three factors of error, I conclude that the astronomical world will be fortunate if it is able to reconcile all the observations so as to make it certain that the accepted average is not more than 100,000 miles in error, or one part in 900 of the whole distance.

There is no reason to doubt that we already know the distance of the sun to within 300,000 miles. I speak not now of my own calculations of the quantity, but of the extremes claimed by others. If we assume 91,700,000 miles as the average, this estimate will not be more than 200,000 miles from the 92,000,000 miles of Newcomb, or the 91,480,000 miles of the English computers. This is one part in 300 of the whole distance. Hence, the probability is that observations of the transit of Venus in 1874, on which more than one million dollars have been expended, and involving the equivalent of not less than 200 years of labor on the part of one man, will only reduce the uncertainty to about one third of its present magnitude. But this will be no mean achievement. It is not saying too much to claim that this result will be worth at least ten times the money and labor expended in obtaining it.

The Great Fire of October, 1871, is responsible for the fact that Chicago is taking no part in the work of to-night. But for that catastrophe, our city would undoubtedly have been represented in the corps of observers of the Transit of Venus. Less than two months before we were overtaken by that calamity, I canvassed the subject with several members of the Astronomical Society; and, only a few days previous to the time when the best part of our city was laid in ashes, I finished a communication, intended to have been laid before the Society, proposing that it should be represented at or near Pekin, in China, and that the subject be referred to a Committee of Ways and Means. It was then understood, and afterwards known, that the Government of the United States would furnish transportation and rations free; and it would not have been difficult to raise the money necessary to meet the other expenses incident to the undertaking. But the fire burned up the document and the means of the Society, and it was impossible to pursue the subject further. It is, however matter for congratulation that the station then recommended is occupied to-night by Profs. Watson and Young, two of the closest observers the world can boast, and that the observations now in progress will be numerous enough to insure the greatest attainable accuracy, notwithstanding the failure of Chicago to take part in the work.

Mr, Colbert received a good deal of applause at the conclusion of his address.

Mr. W. W. Calkins followed, reading a paper entitled "The Development of Natural History as a Science-" The following is a digest of the paper.

The great and lamented Agassiz said, "I have devoted my whole life to the Study of Nature, and yet a single sentence may express all that I have done." This confession reveals to us a degree of simplicity and grandeur not often witnessed. It suggests that the grace of modesty might be cultivated by most people with great propriety. Since man was first created he has been engaged in studying the world of animate and inanimate objects around him. As the first rude efforts seem to us like childish displays, so, when the present era shall become antiquity, our attainments in knowledge will no doubt appear small indeed in comparison with the advances that shall mark futures ages.

Aristotle was the first prominent naturalist, and the founder of the science. As evidence of this, we have his "History of Animals." In Aristotle's time, 2,000 years ago, text-books of natural history were in common use, and the study was pursued with vigor. We are still without elementary works of this kind adapted to the young beginners. We are, however, working up to the point when the study of natural history in the school will be indispensable and popular. After 1500, Linnaeus resumed the work where Aristotle had left it. Pliny added but a little to what had been done by Aristotle. The Middle Ages, with an intellectual pall dark as night, followed the enlightened period of Roman and Grecian history, and gave us nothing. The sixteenth century witnessed a temporary revival in this and other branches of learning. The naturalists were mainly occupied in studying local species, and in disputing over ancient authors. The seventeenth century witnessed remarkable advances in general knowledge, but men had not yet done wondering over the successful revolt of the Netherlands, or the brilliant military career of Gustavus Adolphus, Wallenstein, and Tully

It was reserved then for Linnaeus, in the last century, to break the spell that had for so many ages been hung over the pursuit of the natural sciences, and strike the key-note that aroused the scholars of Europe from their lethargy. Aristotle had given us genera and species; he divided the animal kingdom into *Enaima* and *Anaima*, or blooded and bloodless animals. Linnaeus, beginning where Aristotle left off, formed, in addition, classes and orders. He divided the animal into six classes—mammalia, birds, reptiles, fishes, insects, and worms. The classification at once aroused the attention and provoked the criticism of other naturalists. The defects were pointed out, and the important principle of classification founded upon the internal structure, and uniting animals upon common structural characters, was established. The magnitude of the work of classification will be appreciated when we consider that the species now number 230,000. The confusion that existed before Linnæus' time on account of the diferent names and languages employed by naturalists was counteracted, and in fact done away with by the use of one language by him—the Latin.

Linnæus' classification, however, did not meet with entire success. Its defects did not escape criticism from Lamarck, Ehrenberg, Von Baer, Cuvier, and other great naturalists. All, with the exception of the great Cuvier, failed to strike the grand principles of classification. When he announced his theory dividing the whole animal kingdom into four classes—Vertebrates, Mollusks, Articulates, and Radiates—the scientific world stood amazed, as though a revelation had been made from Heaven. The founder of comparative anatomy was not one who skimmed over the surface of things. Cuvier went deeper; he examined the internal organization and revelations of animals. He tells us the comparison was the secret of his success. The result embodied the four plans of creation already mentioned. The views of Cuvier, which have withstood criticism for nearly three quarters of a century, lead to three conclusions: First, that Cuvier's four classes embrace all known animals. Second, that there is thought and harmonious law as the basis of all, the whole directed by one will—the Creator. Third, that the numerous subdivisions of the four great groups mentioned, such as classes, orders, families, genera, species, and other subdivisions of these subdivisions, should be formed in accordance with characters expressed in nature to be of value. Otherwise they are artificial distinctions tending to lead us away from what we seek, and that which is the basis of all science—the truth.

Another great discovery hardly less important than those mentioned was that of Von Baer in embryology—or the fact that all animals originate from eggs, and though all alike at first, grow to maturity on four different plans. Embryology is yet in its infancy, Agassiz made some of his greatest discoveries in this science, and it furnishes one of the most attractive and promising fields open to the explorer. The progress of natural history for fifty years has been rapid. The latter part of the last and the beginning of the present century were particularly marked by great discoveries. The present century has produced hosts of distinguished naturalists who have laborod successfully in their particular departments, but Agassiz, before his death, probably ranked first among living contemporaries.

Mr. Calkins closed by saying that the study of natural history should be popularized.

The President announced, at the conclusion of Mr. Calkins' lecture, that miscellaneous business was in order. There was no response, and a motion to adjourn was put and carried.—*Chicago Tribune.*

Thomas A. Scott, was elected President of the Northern Central Railroad December 8.

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